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Effectiveness of Manipulative Media in Improving Learning Outcomes of Fraction Addition in Elementary School

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Abstract

Learning done by teachers is still conventional and minimal in the use of concrete learning media. So this study aims to examine the effectiveness of using manipulative media in improving math learning outcomes, especially in the material of adding fractions with different denominators in elementary schools. The method used is library research with a descriptive qualitative approach. Data were obtained through a literature search on Google Scholar, with the criteria of relevant articles, accessible in fulltext, and published in the last six years (2018-2024). Of the 20 articles found, 6 of them were analyzed further because they had a direct relationship with the research topic. The results of the analysis showed that the use of manipulative media, whether in the form of paper, blocks, or transparent mica, proved effective in improving students' concept understanding and learning outcomes. This finding is reinforced by the significant increase in students' learning evaluation scores in various studies. Therefore, manipulative media is recommended as an alternative for interactive and meaningful learning in teaching mathematics at the primary school level.

Keywords: *fractions, learning mathematics, learning outcomes, manipulative media*

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INTRODUCTION

Education plays a very strategic role in shaping quality human resources [1], which is not only superior but also has competitiveness in the global era. This persistence is also supported by national policies that aim to advance the quality of education in order to realize “knowledgeable, technological, superior and noble human beings” as a provision for the future Indonesian nation. Among several fields of science, [2] mathematics has an important role in developing the intellectual aspects of students. Through the introduction of mathematics, learners can be invited to think logically, analytically, critically, and independently [3] which is eternal which is needed in everyday life and the work field. However, the reality shows that students' abilities in mathematics are far from expected. Evidenced by the results of international studies such as the Program for International Student Assessment and Trends in International Mathematics and Science show that Indonesia is consistently below the average of OECD countries in the discipline of mathematics [4].

The phenomenon of low student achievement in mathematics shows that the learning process in schools still faces various challenges. One of the main

problems lies in teaching methods that are still conventional and do not involve students actively in the learning process (Murni et al., 2022). In addition, the lack of use of concrete learning media is also a factor in causing students to have difficulty understanding abstract mathematical concepts. This condition is evident in the learning of fraction addition material with different denominators. Based on the results of interviews with fifth grade teachers, it is known that most students have difficulty in understanding and completing the operation of adding fractions with unlike denominators, which has an impact on their low learning outcomes.

Analysis of the learning outcomes shows that most students have difficulty in understanding the basic concepts of fractions, including in equalizing denominators and performing addition operations correctly [5]. This problem is exacerbated by the one-way learning approach, where the teacher dominates the teaching process without providing sufficient space for students to explore concepts independently. This learning model not only makes students bored quickly, but also inhibits their active involvement in the learning process [6]. As a result, students have difficulty in understanding the material and experience obstacles in achieving optimal learning outcomes.

To overcome problems in learning, an innovation is needed that not only changes the strategy, but is also able to foster student motivation to be more active and really understand the material. One innovation that can be applied is the use of manipulative media. This media serves as a tool that bridges students' understanding of abstract concepts in mathematics, making them more concrete and easy to understand [7]. As explained by Muhsetyo in [5], manipulative media are physical objects that can be touched and manipulated by students to represent real mathematical concepts. In learning fractions, for example, the use of circular or square pieces of paper, fraction blocks, or transparent mica can help students understand the process of equalizing denominators and adding fractions visually and directly. With this approach, students not only memorize the steps, but also understand the meaning behind each process they do.

Learning that involves manipulative media tends to be more interesting for students because it is interactive and fun. Learning activities become more lively because students can participate directly in the concept exploration process. This has an impact on increasing learning motivation, student involvement in discussions, and improving concept understanding.

Several previous studies support the effectiveness of this approach. [8] found that the use of manipulative media in the form of transparent mica can improve students' understanding in solving abstract math problems. The study emphasized that manipulative media can reduce students' cognitive load in understanding complex mathematical processes. On the other hand, [9] proved that the use of transparent mica manipulative media can improve student learning outcomes compared to conventional learning. These two studies show that manipulative media has been proven effective in improving student learning outcomes.

Based on these findings, this study will also use manipulative media as a learning strategy to improve students' understanding of fraction addition material with different denominators. This implementation is expected to overcome the weaknesses of conventional learning that is still widely applied in elementary

schools, especially in mathematics learning. By presenting real context and direct experience in learning, students will more easily understand concepts, develop critical thinking skills, and show improvement in learning outcomes [10].

RESEARCH METHOD

This research is a type of library research with a descriptive qualitative approach. Data were obtained through a literature search using Google Scholar, referring to a study from [11]. From the search results, 20 articles were found, and after selection, 6 articles were declared relevant to the topic of using manipulative media to improve math learning outcomes, especially on fraction material. The selected articles also met additional criteria, namely that they were available in full text version and could be downloaded freely. This study presents data in the form of text descriptions directly sourced from the literature. The data analysis process follows steps adapted from the Miles and Huberman model, which includes the stages of data collection, data reduction, and presentation and conclusion drawing [12][13][14].

RESEARCH RESULTS AND DISCUSSION

Based on the results of the literature study that has been conducted, a number of evidence were found that support the feasibility of using manipulative media in learning mathematics, especially on fraction materials at the elementary school level. The use of manipulative media is an alternative learning strategy that has proven effective in helping students understand abstract concepts in mathematics to be more concrete and meaningful. Learning math using concrete media not only improves student understanding but also provides a more enjoyable and interactive learning experience. This is especially important in fraction material which is often one of the topics that are difficult for elementary school students to understand.

Integration of Active Learning Models

Several studies have shown that the application of manipulative media in mathematics learning can significantly improve student learning outcomes. Research conducted by [15] shows that the use of the Problem Based Learning (PBL) learning model combined with manipulative media can significantly improve student learning outcomes. In this study, the percentage of learning completeness increased progressively, from 13.79% in the pre-cycle to 62.07% in cycle I, and increased again to 86.21% in cycle II. This shows that the integration of active learning approaches with manipulative media can have a positive impact on the achievement of student learning outcomes.

Use of Manipulative Media in Fraction Learning

Furthermore, research conducted by [16] also strengthens the previous findings. The study highlighted the effectiveness of manipulative media in learning addition of fractions with different denominators. Student learning outcomes increased significantly from 42% in the pre-cycle to 76% in cycle I and reached 90% in cycle II. This increase shows that manipulative media not only helps students understand concepts more deeply but also encourages them to be more active in the learning process. With students' active involvement in media

manipulation activities, their mathematical thinking process is facilitated more optimally.

Effectiveness of Transparent Mica Media

Another study by [9] used manipulative media in the form of transparent mica. The results showed that the use of this media was more effective than the conventional learning method. The average learning outcomes in the class using transparent mica media reached a score of 75.8, while the class using conventional methods only reached a score of 56.2. In addition, the t-test results show a value of 3.623 which is greater than the t-table value of 1.684, meaning there is a statistically significant difference between the two groups. This finding confirms that the use of manipulative media can make a meaningful contribution in improving students' mathematics learning outcomes.

Collaborative Contextual Learning Model

[17] in their research used the Realistic Mathematics Education (RME) model combined with manipulative media. The results showed that this approach was effective in improving the understanding of fraction concepts. The average student pretest score before treatment was 46 and increased to 88 after treatment. The t-test conducted resulted in a value of 7.231 with a degree of freedom (db) of 40 and a significance level of 5%. The t-count value, which is greater than the t-table (1.684) indicates that the increase in student learning outcomes is significant. This finding further strengthens the argument that manipulative media, when used in an appropriate learning approach, can provide optimal results.

Research [18] also supports the effectiveness of manipulative media, especially those made from paper. This media not only improves learning outcomes but also encourages student activity during the learning process. Increased student activity is an important indicator in a meaningful learning process, as it shows students' active involvement in understanding the material. Similarly, [8] showed that the use of transparent mica media can improve student learning outcomes on fraction addition material. There was an increase in learning outcomes of 20.8%, from 62.5% in cycle I to 83.3% in cycle II.

Overall, these research findings corroborate that manipulative media is an effective and relevant learning strategy in the context of mathematics education in primary schools. It provides concrete learning experiences and allows students to build understanding through direct exploration of the objects studied. Not only does it improve learning outcomes [7], manipulative media also plays a role in increasing students' learning motivation and active participation in the learning process.

The use of manipulative media in learning mathematics, especially on fraction materials, can make the learning process more interesting and fun [19]. This media allows students to interact directly with concrete objects, so they are more enthusiastic in participating in learning. In addition, direct manipulation of the media helps students understand mathematical concepts and procedures more easily and meaningfully. In the context of elementary school students who are at the concrete operational stage according to Piaget's cognitive development theory, learning through manipulative media is very suitable because it supports their way of thinking which still needs the help of real objects to understand abstract concepts [7].

Furthermore, manipulative media can also be used as a tool for learning differentiation, especially in heterogeneous classes. Students with visual and kinesthetic learning styles will be greatly helped by the presence of media that can be seen and touched directly. In inclusive learning, manipulative media can also be adapted to support students with special needs, such as students with mild cognitive disabilities or students with communication barriers. This shows that manipulative media has high flexibility in supporting diverse learning needs in the classroom.

Therefore, the use of manipulative media in mathematics learning is not only pedagogically relevant but also supported by various empirical evidence. Teachers as facilitators need to have creativity in designing and using manipulative media that are contextual and in accordance with student characteristics. With good planning, this media can be an effective tool in improving the quality of mathematics learning, especially in understanding the concept of fractions as a whole and meaningful.

CONCLUSION

Based on the analysis of six relevant articles, it can be concluded that the use of manipulative media in learning mathematics, especially on fraction materials, has a positive impact on the learning outcomes of elementary school students. Manipulative media can help students understand abstract concepts more concretely and visually, increase involvement in the learning process, and encourage significant improvement in learning outcome. This finding provides evidence that learning strategies that integrate manipulative media need to be applied more widely by teachers as an innovative effort in overcoming mathematics learning difficulties at the primary level.

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